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Microeconomic Distortions

Static Losses and their Effect on the Efficiency of Investment

Ramón López

Trade distortions can reduce the social efficiency of investment. Even a moderate, uniform tariff of 50 percent could reduce the efficiency of investment by almost a quarter.

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In the past decade the developing countries have tried much harder to achieve macroeconomic stability than they have to eliminate inefficiencies from microeconomic distortions.

López has pursu a relatively new line of inquiry in examining measurement of the social income losses induced by the reduction of the investment efficiency caused by trade distortions.

Empirical findings of the study suggest a strong negative effect of trade distortions on the social efficiency of investment. Even a moderate, uniform tariff of 50 percent could cause a reduction in the efficiency of investment of up to 23 percent compared with a 0 percent tariff.

The (social) income losses caused by the reduced investment efficiency are considerable. Countries that have a moderate investment ratio (about 20 percent of GDP) can experience social income losses in excess of 18 percent in 30 years if tariffs are about 50 percent.

The existence of labor market distortions causing unemployment may increase the social value of capital. Capital accumulation moves the economy closer to the production possibility frontier by increasing employment.

This study confirms earlier findings about the relatively modest efficiency losses caused by the independent effects of specific distortions. López also found, however, a significant synergistic effect when trade and wage distortions coexist and lead to larger efficiency losses.

The key issue is the combination of price distortions favoring capital-intensive activity with wage distortions that cause unemployment and underemployment. This pattern of distortion is pervasive in developing countries.

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Table of Contents

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Microeconomic Distortions: Static Losses, Synergy and their Effect on the Efficiency of Investment

During the last decade less developed countries (LDCs) strived much harder to achieve macroeconomic stability than to eliminate inefficiencies arising from microeconomic distortions. Policy makers in LDCs have been in most cases quite reluctant to implement even mild reforms to reduce microdistortions regardless of the country's growth performance and degree of macroeconomic stability.[1/] Several prominent economists, on the other hand, have recently provided intellectual support to this situation. Dornbusch (1990), Krugman (1990), and Rodrik (1989) among others have espoused the idea that macroeconomic stability is central to growth while microeconomic distortions are at best of secondary importance. For example, Dornbusch (1990) states, "In a first round the country should move from quotas and licenses to a uniform, high tariff of say 50 percent. Later, when the economy booms and the external balance can support liberalization without the risk of an exchange crisis, tariffs can be taken down to 10 percent."[2/] Dornbusch and others argue that macroeconomic stability is a necessary condition (the sufficient one would be debt reduction and official stabilization loans) to bring capital back to LDCs and enable them to grow at a rapid pace. By contrast, the removal of distortions in areas of trade, labor markets, financial sector, and agricultural pricing will generate only a once-and-for-all (small) efficiency gains and thus should proceed only to the extent that it does not make the achievement of macroeconomic stability more difficult.

1/ This reluctance of policy makers in removing microdistortions is probably due to the political power of pressure groups that have historically benefitted from the existing distortions. The resistance to remove distortions is clearly shown by the fact that after a decade of massive efforts and money provided by the World Bank, other international organizations and Western governments to support "structural adjustment" in LDCs, only a few of them have made any real progress in this respect on a sustainable basis.

2/ Needless to say, given the general lack of interest of policy makers in removing distortions, the 2nd and "less important" stage of the Dornbusch proposal is not likely to be put in place in the near future.

This view relies on two basic premises, one of them explicit and the other one not always articulated: (1) the once-and-for-all efficiency gains of removing distortions are small, and (2) the social efficiency of investment is not seriously hurt by the microdistortions. The first premise is obviously necessary because if the static gains are indeed large, whether occurring on a once-and-for-all basis or distributed through time resembling slower "economic growth" for a period of time, more serious consideration would need to be given to the possible trade-offs between delays in achieving macrostability and the removal of distortions. The existing studies aimed at measuring the potential gains from removing distortions rely on computable general equilibrium (CGE) models. The evidence from these studies is that efficiency gains from the removal of trade distortions are relatively small - typically 2% of the GDP or less.[3/] These studies may, however, underestimate these gains if trade distortions coexist with factor market and other distortions provided that a synergy or mutually reinforcing effect takes place.

An essential feature of the structure of distortions in a large number of LDCs is that high protection to capital-intensive import-competing activities coexists with important real wage distortions (Krueger, 1978; Bhagwati, 1978). There are good reasons to expect that the effects of real wage distortions and tariff protection tend to reinforce each other when tariffs protect capital intensive sectors. A tariff increase in this case may cause a fall in employment due to the shifting of the structure of the economy further toward capital intensive activities. Thus, in this case a tariff would not only lead to price efficiency losses but also would cause the economy to move further inside the production possibility frontier. Similarly, a worsening of the real wage distortion would not only move the economy inside the production frontier but also would worsen the effect of the tariff distortion by expanding capital intensive activities and reduce labor intensive outputs.

3/ The exceptions are Harris (1984) who employs a model with economies of scale and product differentiation and de Melo et al (1986) who obtained larger gains by considering rent seeking activities arising from trade distortions.

The second premise is perhaps even more relevant despite that is rarely explicitly discussed in this context. If the social efficiency of investment is seriously affected by distortions, the rapid capital accumulation effort that macro stability may bring will be largely wasted if the distortions are maintained. Distortions create a wedge between the private rate of return of capital and the social one, and thus a high private rate of return may be consistent with a low (even negative) social rate of return of capital if distortions remain in place. The existence of this wedge has two possible implications. First, due to lack of confidence of investors exercising their "waiting option," the international effective interest rate may be between the private and the social rate of return of capital before the macroreforms. If investors' confidence is restored by improved macroeconomic stability while keeping domestic distortions, capital inflows will occur. But since the marginal cost of capital (i.e., the international interest rate) is greater than the social return of capital, the country will necessarily experience a net loss of income. This is of course the well known case of immiserizing growth that occurs when capital accumulation is financed out of foreign savings (Bhagwati, 1973, Brecher and Diaz-Alejandro, 1977). This argument considerably weakens the case for macro stabilization maintaining high tariff rates supported by Dornbusch and others at least for countries that are likely to finance the increased capital accumulation mostly out of foreign savings.

The second possibility, which is the most pertinent to this paper, concerns the case when capital accumulation is primarily financed out of domestic savings. In this case, immiserizing growth does not necessarily take place as shown by Johnson (1967), Bertrand and Flatters (1971) and Martin (1977).[4/] This literature shows the conditions under which capital accumulation financed out of domestic savings is immiserizing and, more generally, the conditions under which increasing tariffs to capital intensive goods will decrease the social return of capital. A problem of directly applying these analyses to real

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4/ This is also a problem that the literature on negative shadow prices deals with (i.e., Srinivasan and Bhagwati, 1978).

empirical situations is, however, that the models used are "even," and assume that all firms are identical up to a scale factor. This implies that in the long-run, the zero profit condition in a small open economy determines the private factor returns independently from factor endowments.[5/] Empirically one needs to relax these assumptions allowing for "uneven" models and heterogenous firms.

A central empirical question is, therefore, whether microdistortions cause a significant loss in the efficiency of investment. If the distortions protect capital intensive sectors then the social return of capital is less than the private return and vice versa if the domestic distortions protect the labor intensive activities. If the microdistortions bias the structure of production toward capital intensive activities then capital accumulation will exacerbate the effects of the distortions by inducing an even greater expansion of the capital intensive sectors in detriment of the labor intensive sectors which were already being produced below the social optimum. Thus in this case the social marginal effect of capital is equal to the private return less the loss in welfare caused by the worsening of the effect of the distortion associated with capital accumulation. Alternatively, if tariffs protect labor intensive outputs then there is a welfare loss because capital intensive output levels are too low relative to labor intensive outputs. In this case, capital accumulation by promoting greater relative growth of capital intensive activities will cause a reduction of the tariff induced welfare loss. Hence, the social return of capital is higher than the private one by the extent by which the negative effect of the tariff distortion is reduced by increasing capital.

As shown in Section I, the fact that the social rate of return of capital is below the private one in the presence of distortions, however, does not necessarily mean that a reduction of such distortions will lead to a higher social rate of return.[6/] Reducing distortions that protect capital intensive activities has two opposing effects on the social rate of return: (i) the wedge between the private and social rates is

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5/ Or, equivalently, the revenue function becomes linear in the long-run.

6/ In the Heckscher-Ohlin "even" model, however, reducing distortions favoring capital intensive activities necessarily increase the social shadow price of capital.

reduced thus causing the social rate to increase at a given private rate; (ii) the private rate of return is reduced thus having the opposite effect on the social rate. The net effect of reducing distortions on the social rate is thus an empirical matter. If microdistortions actually reduce the social efficiency of investment then there would be additional dynamic welfare losses for countries where increasing the aggregate capital/labor ratio is an important source of growth as is the case for practically all LDCs.[7/] It is surprising that despite the large number of empirical studies devoted to measuring the welfare losses originated in economic distortions, the evaluation of the possible losses due to decreased investment efficiency has never been performed.

The purpose of this paper is to conceptually and empirically evaluate the two premises just discussed. Specifically, we intend to: (i) analyze and empirically estimate the magnitude of the social loss caused by the combination of tariff distortions and real wage distortions; (ii) reconsider the conventional models used to analyze the relationships between tariffs and the marginal social efficiency of capital by incorporating the existence of both trade and labor market distortions and by relaxing the "even" assumption so pervasive in the theoretical literature on immiserizing growth; and (iii) empirically measure the dynamic welfare losses that may exist if distortions reduce the social return of capital.

The empirical part of the analysis uses data from Chile for the period 1974-89. Rather than using parameters from different sources, we proceed with a comprehensive econometric estimation of all the required parameters within a unified empirical framework. This goes a long way in solving the problem of consistency so prevalent in analyses of this nature when parameters obtained from different sources are incorporated into CGE models. We choose the case of Chile to illustrate the analysis mostly because

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7/ The fact that the capital/labor ratios rapidly increase through time is a justification for focusing on the social efficiency of capital rather than of labor. Distortions that reduce the social efficiency of capital may at the same time increase that of labor. These distortions would cause dynamic welfare losses due to investment efficiency reductions but also dynamic gains if employment is also increasing through time. However, if the capital/labor ratio is increasing through time, the net dynamic welfare effect under constant returns to scale will still necessarily be negative.

of the transparency of the microdistortions (particularly the trade distortions that consist in a uniform tariff rate) and the availability of good time series data. Moreover, we show that the structure of distortions in Chile, in particular the combination of protecting capital intensive activities and wage distortions, is quite representative of what prevails in the majority of LDCs although the distortions are substantially more moderate and fewer than in most other countries. Therefore, one would reasonably expect that the results for Chile are relevant to many other countries as well.

The remainder of this paper is organized as follows: in section I we present a conceptual framework followed by section II that introduces the empirical model, econometric results and an evaluation of the static welfare losses caused by the coexistence of tariff and labor distortions. Section III is devoted to the evaluation of the investment efficiency effects of distortions and corresponding dynamic social income losses. In section IV we discuss the applicability of the results for Chile to other countries and the last section summarizes the main conclusions.

I. The Conceptual model

We assume that the import substitution sector includes two industries, one producing final goods and the other producing intermediate goods. The rest of the economy is comprised of an export sector. We define social income as aggregate GDP evaluated at world prices. If the trade distortion consists of a uniform tariff, social income is equal to GDP at domestic prices less the rents accruing to domestic producers of import substitutes due to the tariff,

$$(1) \qquad R^* = R\left[(1+\tau)p_1^*, p_2, (1+\tau)p_3^*; L, K, t\right] - \tau\left[p_1^* R_1[\cdot] + p_3^* R_3[\cdot]\right],$$

where R* is the GDP at world prices, R, is GDP at domestic prices, τ is the tariff rate affecting final import substitutes and (imported) intermediate inputs; p_1^* and p_3^* are their respective world prices, p_2 is the price of exportables, L is actual employment, K is the stock of capital and t a vector that may include

other sector specific fixed factors of production such as land, natural resources, etc. as well as an index of technology. Also, $R_1(\bullet)$ and $R_3(\bullet)$ denote first partial derivatives with respect to the first and third arguments. Thus from Hotelling's lemma, $R_1 = Q_M$ and $R_3 = -Z$ where, Q_M is the domestic production of (final) import substitutes and Z the net demand for imports of intermediate inputs. In the absence of quantitative restrictions to imports $(1+\tau)p_1^*$ and $(1+\tau)p_3^*$ are the domestic prices of the final and intermediate import substitutes, respectively.

The ensuing analysis of microdistortions and the efficiency of capital will be entirely based considering R^* rather than directly welfare. Of course, there is a one to one correspondence between the social efficiency of capital measured as its effects on R^* and welfare. Similarly, in analyzing the static welfare effects of wage distortions and tariffs affecting intermediate inputs that are not directly consumed the effect on R^* is equivalent to the effect on welfare. This is so because capital accumulation, wage distortions and tariffs on intermediate inputs can affect welfare only through their effects on R^*. The only problem of not considering welfare explicitly is in accounting the effects of a tariff on final importables. Tariffs on importables affect welfare through both, their effects on R^* and directly through consumption expenditures. The latter effect is due to the fact that a tariff on final importables also causes a consumption distortion. One possibility is to interpret τ as a production subsidy on final importables rather than as a tariff on imports of final goods.

The fact that (1) does not explicitly considers non-tradable goods does not reduce the level of generality of the analysis. As Dixit and Norman (1980) showed, under the usual instantaneous market clearing and price homogeneity assumptions, the price of non-tradables is a linearly homogenous function of the domestic prices of all tradable goods. This, in turn, implies that $R(\bullet)$ can be interpreted as a reduced form revenue function once the price of non-tradables has been substituted in. Under the

assumption of constant returns to scale it can be shown that all the properties of the original revenue function are preserved in this "reduced form" specification.[8/]

Due to the existence of distortions in the labor market, there is unemployment and, hence, the employment level is endogenous. We assume that the wage rate is equal to the market clearing wage rate (i.e., the wage that would be consistent with full employment) plus a mark-up that is not necessarily fixed. Thus,

$$(2) \qquad w = w^* + \mu(w^*; \theta),$$

where w^* is the notional market clearing wage rate, $\mu(\bullet)$ is a mark-up function, and Θ is any exogenous variable (i.e., unions market power) that may affect the mark-up. A negative value for $\partial\mu/\partial w^*$ implies that, ceteris paribus, the richer an economy is the smaller will be the wage mark-up. Expression (2) is a generalization of various frequently used wage specifications. If, for example, $\partial\mu/\partial w^* = -1$, then wages are rigid. If $\partial\mu/\partial w^* = 0$, wages are fully flexible, responding to market changes, although actual wages are at a higher level than market clearing wages.[9/]

The value of w^* is determined by

$$(3) \qquad R_{L^*}[(1+\tau)p_1^*,\ p_2,\ (1+\tau)p_3^*;\ L^*,\ K,\ t] = w^*,$$

where L^* is the full employment level and R_{L^*} is the marginal revenue product of labor evaluated at L^*. Finally, the actual level of employment is determined by

$$(4) \qquad R_L[(1+\tau_1)p_1^*,\ p_2,\ (1+\tau_3)p_3^*;\ L,\ K,\ t] = w.$$

8/ In the empirical analysis we do allow for non-tradables explicitly. In order to make the empirical analysis compatible with the conceptual model described in this section we also estimate a reduced form equation for the price of non-tradables and calculate all elasticities by including the direct as well as the indirect effects via the price of non-tradables.

9/ See Lopez and Riveros (1990) for more details about the theoretical foundation of (2).

Now we can define more rigorously the labor market distortion by $\eta \equiv (w-w^*)/w^* = \mu/w^*$, as the proportion by which the actual wage rate is above the market clearing wage rate. Here we assume that the wage distortions apply to the complete labor market and, thus, for any $\mu>0$ there is open unemployment. More realistically one would need to assume that the wage distortion only affect the formal sector labor market where the labor regulations are binding and union activity is more prevalent.[10/] In this case, open unemployment would affect only those willing to work exclusively in the formal sector, while those willing to work in the informal sector would not be openly unemployed, although their wages and productivity would be substantially lower (underemployment). For our purposes, however, all that matters is that a wage distortion will cause a fall in effective employment whether through open unemployment or underemployment related to the increased labor market segmentation that such a distortion causes.

Thus, the existence of labor market distortions and the "uneven" nature of the model (remember that we are assuming the existence of sector specific, fixed factors represented by vector t in R(•) imply that we cannot use the zero profit conditions to determine the wage rate and the private return of capital as functions of only output prices as in the Heckscher-Ohlin model. The specific conditions for immiserizing growth (or negative shadow price of capital) and in general for an inverse relationship between tariffs and the social or shadow price of capital will thus be quite different from those derived in studies using the "even" Heckscher-Ohlin model.

Consider first the static losses due to tariffs in the presence of said wage distortions. Differentiate totally expression (1) with respect to τ and express it in logarithmic form,[11/]

10/ See Lopez and Riveros (1990) for an analysis of labor market segmentation.

11/ Keep in mind that strictly speaking the correct interpretation of τ for final goods is that of a production subsidy rather than a tariff. Henceforth we will refer to τ indistinctly as a tariff on production subsidy.

$$(5)\quad \frac{d\ln R^*}{d\ln\tau} = -\left(\frac{\tau}{1+\tau}\right)^2 \frac{R}{R^*}\left\{S_M\frac{\partial lnQ_M}{\partial lnp_1} + 2S_M\frac{\partial lnQ_M}{\partial lnp_3} - S_Z\frac{\partial lnZ}{\partial lnp_3} - \frac{1+\tau}{\tau}\frac{\partial lnL}{\partial \ln\tau}\left[\left(\frac{1+\tau}{\tau}\right)S_L - S_M\frac{\partial lnQ_M}{\partial lnL} + S_Z\frac{\partial lnZ}{\partial lnL}\right]\right\}$$

where $S_L \equiv [(\partial \ln R)/(\partial \ln L)]$ is the share of labor in (private) income, $S_M \equiv [p_1Q_M/R]$, $S_Z \equiv [p_3Z/R]$ are the shares of final importable production and of imports of intermediates in total income R, respectively. It can be shown that the elasticity of employment with respect to the tariff is

$$(6)\quad \frac{\partial \ln L}{\partial \ln \tau} = \frac{\tau}{1+\tau}\left(\frac{\partial \ln L}{\partial \ln p_1} + \frac{\partial \ln L}{\partial \ln p_3}\right)$$

and that $\dfrac{R}{R^*} = \dfrac{1+\tau}{1+\tau(1-S_M+S_Z)}$.

The first three terms of the left-hand of expression (5) account for the conventional efficiency losses of increasing the tariff or production subsidy on importables. If the domestic production of import substitutes increases and imports of intermediate inputs decline (i.e., which is likely to occur when domestic production of intermediates expands), in response to a tariff increase, efficiency losses worsen. In fact, given a single tariff the sum of the first 3 right-hand terms inside the bracket is necessarily positive indicating that social income decreases when the tariff goes up. The last 3 right-hand terms account for the employment effect of raising a tariff. If employment falls after the tariff increase, i.e., if $[(\partial \ln L)/(\partial \ln \tau)] < 0$, there is a further social loss by moving the economy further inside the production possibility frontier. This is captured by the 4th right-hand term in (5). The last 2 right-hand terms account for the indirect efficiency effects caused by employment changes. If employment falls, Q_M is likely to further increase and Z to fall if these goods are capital intensive, i.e., if $[(\partial \ln Q_M)/(\partial \ln L)] < 0$ and $[(\partial \ln Z)/(\partial \ln L)] > 0$. In this case, the social loss of the tariff is increased further.

The effect of a wage distortion on social revenue in the presence of a tariff distortion can be estimated by logarithmic total differentiation of (1)

$$(7) \qquad \frac{d\ln R^*}{d\ln \eta} = \frac{\eta}{1+\eta}\frac{R}{R^*}\frac{\partial \ln L}{\partial \ln \eta}\left[S_L - \frac{\tau}{1+\tau}\left(S_M \frac{\partial \ln Q_M}{\partial \ln L} - S_Z \frac{\partial \ln Z}{\partial \ln L}\right)\right].$$

The first right-hand term captures the direct effect of increasing the wage distortion, i.e., the effect of a fall in employment moving the economy further inside the production possibility frontier. The last 2 terms capture the increased losses in efficiency associated with the fall in employment. The employment reduction increases production of capital intensive goods that are protected by the tariff (i.e., $[(\partial \ln Z)/(\partial \ln L)] < 0$) leading to further efficiency losses.

Next we derive an expression for the social return of capital which we simply define as the elasticity of GDP evaluated at world prices with respect to capital. Totally differentiating (1) with respect to K and expressing this in logarithmic form we obtain,

$$(8) \qquad \frac{\partial \ln R^*}{\partial \ln K} = \frac{R}{R^*}\frac{\tau}{1+\tau}\left\{S_K \frac{1+\tau}{\tau} - S_M \frac{\partial \ln Q_M}{\partial \ln K} + S_Z \frac{\partial \ln Z}{\partial \ln K} + \frac{\partial \ln L}{\partial \ln K}\left[S_L \frac{1+\tau}{\tau} - S_M \frac{\partial \ln Q_M}{\partial \ln L} + S_Z \frac{\partial \ln Z}{\partial \ln L}\right]\right\}$$

where $S_K \equiv [(\partial \ln R)/(\partial \ln K)]$, is the "private" return of capital, i.e., the percentage change in GDP evaluated at domestic prices due to a one percent increase in the stock of capital.

In order to evaluate expressions (7) and (8) we need to determine expressions for $\partial \ln L/\partial \ln \eta$ and $(\partial \ln L)/(\partial \ln K)$, respectively. Clearly, $[(\partial \ln L)/(\partial \ln \eta)] = \mu\ [(\partial \ln L)/(\partial \ln w)] < 0$ which of course implies that the sign of (7) is minus the sign of the term in square brackets. Thus, one could not in principle rule out the possibility that increasing wage distortions lead to a higher social income if the tariff τ is sufficiently large. This would require that the protected sectors be labor intensive (in which case $[(\partial \ln Z)/(\partial \ln L)] < 0$). As we have seen this is not likely to be the case in LDCs and thus the term in square bracket is likely positive with the effect of the tariff reinforcing the negative effect of η. To obtain an expression for $(\partial \ln L)/(\partial \ln K)$ we use (2), (3), and (4),

$$(9) \qquad \frac{dL}{dK} = \frac{1}{R_{LL}}\left[R_{L^*K}(1+\mu_{w^*}) - R_{LK}\right]$$

where $R_{LK} = [(\partial^2 R)/(\partial L \partial K)] > 0$, $R_{L^*K} = [(\partial^2 R)/(\partial L^* \partial K)] > 0$, and $R_{LL} = [(\partial^2 R)/(\partial L^2)] < 0$ under the assumption of concavity of $R(\bullet)$.

Equation (8) is the basic expression that will guide the empirical work on investment efficiency. The idea is to obtain estimates of the parameters using this expression in order to derive some notion of the social efficiency of capital as opposed to the private one represented by s_k. The correction of s_k indicates how the effect of tariff distortions is worsened or improved by capital accumulation (the 2nd and 3rd right-hand terms) and how the effect of the labor market distortion on social income is affected by an increase in capital (the three terms in square bracket). If the domestic production of final import substitutes (Q_M) is capital intensive then $[(\partial \ln Q_M)/(\partial \ln K)] > 0$ and, hence, the effect of capital accumulation will be to expand further the domestic production of import substitutes which were already overproduced due to the tariff protection. That is, capital accumulation would in this case magnify the effect of the distortion. This would require a negative correction of the private rate of return of capital as shown by the negative sign of the 2nd right-hand term. If production of Q_M is labor intensive then $(\partial \ln Q_M)/(\partial \ln K) < 0$ in which case there would be a positive correction. Similarly, if imports of intermediate inputs are substitutes with capital, i.e., if $[(\partial \ln Z)/(\partial \ln K)] < 0$ capital accumulation would worsen the original distortion by reducing even further the import of intermediates which were below its social optimum due to the tariff. This implies a negative correction on the private return of capital. Substitutability between imports of intermediate inputs and capital may arise because domestic production of intermediate inputs is capital intensive and/or because capital and intermediates are substitute inputs in domestic production.

The second set of corrections are related to the wage distortion which have caused the economy to be inside the production possibility frontier. If there are no wage distortion (no unemployment) $\eta =$

0, $[(\partial \ln L)/(\partial \ln K)] = 0$ and there are no further corrections to make. If, however, $\eta > 0$ an increase in the stock of capital will cause the economy to move closer to the production possibility frontier since in this case $[(\partial \ln L)/(\partial \ln K)] > 0$. This requires a positive correction reflected by the term $[(\partial \ln L)/(\partial \ln K)]$ $s_L (1+\tau)/\tau$. The last two right-hand terms in (8) reflect the indirect efficiency effects associated with the increase in employment. If importable production is labor intensive then $[(\partial \ln Q_M)/(\partial \ln L) > 0]$ which would have a negative effect on the social return of capital because production of a protected output would further increase. Similarly, if an increase in employment induces a reduction on imports of intermediate inputs, the social efficiency of investment would be further reduced.

Finally we consider the net effect of a tariff on the social marginal revenue product of capital. Totally differentiating expression (1) first with respect to K and next with respect to τ we obtain,

$$(10) \qquad \frac{dR_K^*}{d\tau} = -\tau\left[p^{*2} R_{11K} + 2p^* p_3^* R_{13K} + p_3^{*2} R_{33K}\right],$$

where $R_{22K} = (\partial R_{22})/(\partial K)$, etc. We have assumed in (10) that there are no wage distortions. The above effect in the presence of wage distortions is substantially more complex involving several other 3rd order terms. In the empirical sections we will use numerical methods to calculate the equivalent of (10) with wage distortions. Here we only want to illustrate the fact that the net effect of a tariff change on the social return of capital necessarily depends on third order terms. Needless to say, the fact that third derivatives are rarely explicitly considered in most analyses does not imply that they are negligible. The terms R_{22}, R_{33}, are the slopes of the supply of final importables and demand for intermediate inputs. Thus, the key determinant of (10) is how capital accumulation affects the slopes of the supply curves of final importables and demand for intermediate inputs. If these curves become more elastic as capital expands (i.e., $R_{ijk} > 0$, i,j = 2,3) the social efficiency of capital will decrease with the tariff and vice versa.

In contrast with the conventional case the function $R_k \equiv r$, where r is the private rental price of capital, is dependent not only on output prices but also on factor endowments. The fact that the function R(.) is symmetric implies that the term R_{22K}, R_{33K}, R_{23K} correspond to the curvature of the private capital rental price function with respect to the output prices of the two protected goods (i.e., $R_{22K} = [(\partial^2 r)/\partial p_2 2]$, etc. In the Heckscher-Ohlin "even" model r is a convex function of the protected output price. This is due to the concavity of the cost function in factor prices. This implies that the term in square brackets in (10) is necessarily positive and thus, immiserizing growth is always possible in the Heckscher-Ohlin model at a sufficiently high tariff.[12/] Moreover, the social return of capital is always decreasing in τ for $\tau > 0$. In models where the "evenness" condition is not satisfied or in models that do not assume the long-run zero profit condition with identical firms, however, there is no reason to assume that immiserization will take place regardless of the tariff level. In general, there is no reason to impose any restrictions on the third derivatives of the revenue function and thus the social return of capital may be an increasing or decreasing function of tariffs. This is purely an empirical matter.

II. The Empirical Model

The model is estimated for Chile using annual data for the period 1974-1989. The micro policy environment in Chile 1974-89 was very stable, highlighting the role of markets and the private sector as dominant factors. The economy in general was subject to very few distortions with the exception of moderate import tariffs and a period of binding wage indexation extending from 1974 until 1983. The existence of a government enforced backward wage indexation in an environment of declining inflation contributed to maintain real wages substantially above the market clearing wage and to high rates of unemployment. Even after the elimination of official indexation in 1983, indexation practices in the

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12/ Note that the slope of the function r in the output prices gives the sign of $dR_k^*/d\tau$.

private sector lingered for a while. Unemployment, although declining since 1985, continued to be quite high until the late eighties (1988) when the rate of unemployment stabilized at about 7-8%, which is considered to be about the natural rate in Chile. Import tariffs were uniform and fluctuated between 75% in the early part of the period to as low as of 10% in 1982. Between 1983 and 1985 tariffs fluctuated between 15 and 30%. Since 1986 import tariffs have been constant at 15%.

The empirical model is oriented to obtain quantitative estimates of the various elasticities required by equations (5), (7), (8) and (10). In order to obtain consistent estimates of these elasticities in a systematic way we need to derive a comprehensive specification of the structure of production of the economy. We derive and estimate the structure of production using a revenue or GDP function. The revenue function corresponds quite closely to the usual representation of the production structure used in modern versions of international trade models[13/]. In this specification revenue is a function of the various output prices, imported input prices, capital, labor and an index of technology.

II.1 The Revenue or GDP Function

A nominal multi-output revenue or GDP function under the assumption of competitive equilibrium and profit maximization can be represented as follows:

$$(11) \quad R(p_N, p_M, p_x, q; K, L, t) \equiv \max_{Q_N, Q_M, Q_x, Z} \{p_N Q_N + p_M Q_M + p_x Q_x - p_Z Z : F(Q_N, Q_M, Q_x, Z; K, L, t) = 0\},$$

where p_N, p_M, p_x and p_z are the domestic prices of non-tradables, importables, exportables and imported intermediates respectively, Q_N, Q_M, Q_x are the level of domestic production of non-tradables, import substitutes and exportables, Z is the level of net imports of intermediate materials, K is the stock of capital, L is employment, t is an index of technology, and $F(\bullet)$ is the production possibility set.

13/ See, for example, Dixit and Norman (1980).

The (nominal) revenue function is homogeneous of degree one in p_N, p_M, p_x and p_z and, hence, we can choose to normalize by p_x to obtain revenue in units of the exportable commodity. Under constant returns to scale in capital and labor, R(•) is also linearly homogenous in K and L and hence we can express real revenue or GDP per capita as a function of the capital/labor ratio,

$$(12) \qquad \tilde{R} = \tilde{R}(p_1, p_2, p_3; k, t),$$

where $\tilde{R}$ is real per capita GDP expressed in units of the exportable good, $p_1 = p_N/p_x$, $p_2 = p_M/p_x$, $p_3 = p_z/p_x$, are the relative prices of non-tradables, final importables and imported intermediate materials also expressed in units of the exportable price, and $k = K/L$ is the capital/labor ratio.

By Hotelling's lemma (Diewert, 1974) one can obtain the following specification for the output supply and net demand for intermediate inputs,

$$(13) \quad \text{(i)} \qquad Q_N/L = \tilde{R}_1(p_1, p_2, p_3; k, t)$$

$$\text{(ii)} \qquad Q_M/L = \tilde{R}_2(p_1, p_2, p_3; k, t)$$

$$\text{(iii)} \qquad -Z/L = \tilde{R}_2(p_1, p_2, p_3; k, t)$$

$$\text{(iv)} \qquad Q_x/L = \tilde{R}(\bullet) - p_1\tilde{R}_1(\bullet) - p_2\tilde{R}_2(\bullet) - p_3\tilde{R}_3(\bullet)$$

where $\tilde{R}_1(\bullet)$ is the first derivative with respect to p_1, $\tilde{R}_2(\bullet)$ to p_2, etc. Furthermore, specifying a suitable functional form for $\tilde{R}(\bullet)$ one can derive the complete system of estimating equations from (13). We use an extended quadratic specification that allows to estimate the third order terms that will determine the net effect of tariffs on the social return of capital,

$$(14) \qquad \tilde{R} = b_0 + b_N p_1 + b_M p_2 + b_z p_3 + \frac{1}{2}b_{NN}p_1^2 + \frac{1}{2}b_{MM}p_2^2 + \frac{1}{2}b_{ZZ}p_3^2 + b_{NM}p_1p_2 + b_{NZ}p_1p_3 + b_{MZ}p_2p_3 + b_{tt}k$$

$$+ b_{Nt}p_1k + b_{Mt}p_2k + b_{zt}p_3k + \frac{1}{2}\beta_{NNt}p_1^2k + \frac{1}{2}\beta_{MMt}p_2^2k + \frac{1}{2}\beta_{ZZt}p_3^2k + \beta_{NMt}p_1p_2k + \beta_{NZt}p_1p_3k$$

$$+ \beta_{MZt}p_2p_3k + b_tt + b_{Nt}p_1t + b_{Mt}p_2t + b_{zt}p_3t + \alpha_{tt}k^2$$

where the b_{ij}, β_{ijk} and are α_{kk} fixed parameters.

Using (14) in (13) we obtain an explicit representation of the output supply and net demand for intermediate inputs,

(15) (i) $$Q_N/L = b_N + b_{NN}p_1 + b_{NM}p_2 + b_{NZ}p_3 + b_{Nk}k + b_{Nt}t + \beta_{NNk}p_1k + \beta_{NMk}p_2k + \beta_{NZk}p_3k$$

(ii) $$Q_M/L = b_M + b_{NM}p_1 + b_{MM}p_2 + b_{MZ}p_3 + b_{Mk}k + b_{Mt}t + \beta_{MMk}p_2k + \beta_{NMk}p_1k + \beta_{MZk}p_3k$$

(iii) $$-Z/L = b_Z + b_{NZ}p_1 + b_{MZ}p_2 + b_{ZZ}p_3 + b_{Zk}k + b_{Zt}t + \beta_{ZZk}p_3k + \beta_{NZk}p_1k + \beta_{MZk}p_2k$$

(iv) $$Q_x/L = b_0 - \frac{1}{2}b_{NN}p_1^2 - \frac{1}{2}b_{MM}p_2^2 - \frac{1}{2}b_{ZZ}p_3^2 - b_{NM}p_1p_2 - b_{NZ}p_1p_3 - b_{MZ}p_2p_3 + b_{kk}k + b_tt$$

$$- \frac{1}{2}\beta_{NNk}p_1^2k - \frac{1}{2}\beta_{MMk}p_2^2k - \frac{1}{2}\beta_{ZZk}p_3^2k - \beta_{NMk}p_1p_2k - \beta_{NZk}p_1p_3k - \beta_{MZk}p_1p_3k + \alpha_{kk}k^2$$

Relating (15) to expression (10) we have that $R_{ijk} = \beta_{ijk}$. Accordingly, a sufficient condition for the social return of capital to be a decreasing function of the tariff rate or, equivalently for (10) to be negative, is that β_{MMk}, β_{MZk}, $\beta_{ZZk} > 0$. Furthermore, concavity of the revenue function in k requires that $\alpha_{KK} < 0$. Note that the symmetry conditions have been imposed in (14) and (15) thus substantially decreasing the number of parameters to be estimated. Finally, the revenue function should be convex in prices, a condition that is not a priori imposed.

II.2 Estimation Procedure and Results

We estimate the system of equations (15) by specifying a vector of additive disturbances which we assume to be identically distributed normal random vectors with mean vector zero. The model is estimated using an iterative version of Zellner's method for seemingly unrelated regression equations (SUR) which is equivalent to a maximum likelihood procedure. The use of this method allows us to impose the symmetry restrictions thus substantially reducing the number of estimating parameters.

All variables are normalized to unity in 1977 except the time trend variable used to represent t.[14/] In order to allow for the possible endogeneity of the price of non-tradables (p_1) and the capital-labor ratio (k) we use an instrumental variables/principal compone" method to obtain the predicted values for p_1, k, and of all variables that include the terms p_1 and/or k. These predicted values are used in the actual regression equations.

Table 1 reports the estimates of the system of four equations (15). In general, the goodness-of-fit of the estimates judged by the t-statistics is very satisfactory. Moreover, the sign pattern of the coefficients is consistent with the theoretical restrictions implied by competitive profit maximization. In particular, the required convexity properties of $\tilde{R}(\bullet)$ are satisfied at all data points which implies that all the own price elasticities of output supply are positive when evaluated at every sample point. Also, the own price demand elasticity for intermediate inputs is negative at all sample points. Moreover, the negative sign of the α_{KK} coefficient indicates that the revenue function is concave in k.

Another important result shown in Table 1 is the high degree of significance of two of the third order terms (β_{ijk}). This suggests that the effect of tariff changes on the social efficiency of capital is non-trivial (see equation (10)). In particular, the large positive and highly significant value of β_{ZZk} (= R_{33k}) indicates that the effect of a tariff on imports of intermediate inputs has a strong negative effect on the social efficiency of capital. Similarly, the significant and negative value of β_{MMk} (= R_{22k}) implies that a tariff on final importables would increase the marginal social efficiency of capital. As can be seen below the net effect of a uniform tariff affecting both importable goods on capital efficiency is negative. That is, the intermediate input effect largely dominates the effect of a tariff on final importables. According to the analysis presented in section I, this implies that the social or shadow price of capital is generally decreasing in the tariff level. Therefore, at a sufficiently high tariff rate, the social return of capital necessarily becomes negative. Increasing tariff, ceteris paribus, will stimulate greater investment

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14/ See appendix for details about the data set.

due to the fact that the private return of capital increases. But at the same time the social return is reduced, and at a sufficiently high tariff the social return becomes negative. Thus, the possibility of immiserizing gorwth is real even if investment is fully financed out of domestic savings.

Table 1.A shows the estimates of the reduced form equation of the price of non-tradables (p_1). The positive sign of the price of final importables is consistent with the presumption that final importables and non-tradables are substitutes in production and demand. The negative sign of the price of intermediates suggests that an increase in the price of intermediate inputs causes a reduction in national income which in turn decreases domestic demand for non-tradables, thus having a negative effect on the price of non-tradables. The elasticities of Table 1.A are used to calculate the net elasticity of supply and demand consistent with the theoretical framework of section I.

The theoretical consistency of the estimates is more clearly reflected in the plausibility of the price elasticities shown in Table 2. All own price elasticities for the three outputs considered are positive and the own price demand elasticity for (imported) inputs is negative as expected. Among the three outputs the most elastic is the production of import substitutes with an own price elasticity of 0.66, while exportable production is moderately elastic with an elasticity of approximately 0.5 and production of non-tradables is quite inelastic (0.38). All three outputs suffer substantially when the prices of imported inputs increase. Demand for imported intermediates is relatively elastic with an own price elasticity of -0.68.

The net or reduced form price elasticities explicitly considering the effects through the price of non-tradables are shown in Table 2.A. These elasticities add a correction factor to the elasticities in Table 2. For example, the own price elasticity of Q_M is equal to the one reported in Table 2 plus the indirect effect of a change in p_M through the price of non-tradables. This indirect effect is the elasticity of

Table 1. SUR ESTIMATES OF THE REVENUE FUNCTION
CHILE 1974-79

Parameter	Parameter value	t-statistic
b_0	0.61	2.56
b_N	1.26	2.98
b_M	1.05	3.56
b_Z	-2.48	-4.80
b_{NN}	0.59	1.11
b_{MM}	1.98	4.54
b_{ZZ}	-1.93	-3.32
b_{NM}	0.044	0.48
b_{NZ}	-0.80	-5.60
b_{MZ}	-0.34	-1.84
b_{NK}	0.24	0.55
b_{MK}	-0.10	-0.35
b_{ZK}	0.96	2.32
b_t	0.0049	0.88
b_{Nt}	-0.012	-1.54
b_{Mt}	0.019	-3.17
b_{Zt}	0.029	3.01
β_{NNk}	-0.18	-0.36
β_{MMk}	-1.35	-2.81
β_{ZZk}	2.91	5.73
β_{NMk}	0.012	0.15
β_{NZk}	-0.01	-0.25
β_{MZk}	0.0001	0.12
α_{kk}	-2.6	-1.36

Table 1.A. REDUCED FORM OLS ESTIMATES OF THE PRICE OF NON-TRADABLES
CHILE 1974-79
(double log specification)

	coefficient	t-statistic
Constant	0.34	2.90
log p_2	0.54	3.74
log p_3	-0.58	-2.51
log k	0.75	1.65
time	-0.016	-2.74

$R_2 = 0.74$; $\bar{R}^2 = 0.60$
Dw = 2.03 ; F = 6.17 ; N = 15

Q_M with respect to p_N (in Table 2) times the elasticity of p_N with respect to p_M (Table 1.A). That is, the correction factor is $0.05 \cdot 0.84 = 0.042$ which is added to the partial own price elasticity in Table 2 (0.66) giving the net price elasticity of Q_M with respect to p_M (0.71). The elasticities in Table 2.A are consistent with those used in the theoretical expressions derived in Section I. In the calculations of the various effects we thus use Table 2.A rather than Table 2.

Table 3 provides the elasticities of the three outputs and of imports of intermediate inputs with respect to capital. These elasticities already include the indirect effects that take place through the price of non-tradables. These are the key elasticities required to estimate the social return of capital using equation (8). Several important implications emerge from Table 3. First, the fact that domestic production of final import substitutes is negatively affected by an expansion of capital suggests that import substitution of final goods are labor intensive rather than capital intensive. Second, production of exportables is also negatively affected by capital accumulation but in a much less dramatic way indicating that production of exportables is relatively more capital intensive than domestic production of final import substitutes. This is not surprising because Chilean export activities mostly are resource extraction (mining, fishery, forestry, etc.), which are characterized by a moderately high capital/labor ratio. Third, the fact that imports of intermediate goods are so strongly decreased by capital accumulation suggests that domestic production of intermediates is highly capital intensive. This is consistent with casual observation of industries that typically produce intermediate import substitutes in Chile such as steel and petrochemicals, which are considered extremely intensive in capital. Another possible reason explaining the large negative effect of capital on imports of intermediates may be the existence of substitutability between capital and intermediates as inputs in domestic production.

Table 2. PRICE ELASTICITIES EVALUATED AT MEAN SAMPLE VALUES
CHILE 1974-89

	P_N	P_M	P_x	P_Z
Q_N	0.38	0.04	0.32	-0.74
Q_M	0.05	0.66	-0.36	-0.35
Q_x	0.28	-0.37	0.48	-0.39
Z	0.26	0.61	-0.18	-0.69

Table 2.A. NET PRICE ELASTICITIES CONSIDERING THE EFFECTS THROUGH THE PRICE OF NON-TRADABLES
CHILE 1974-89

	P_M	P_x	P_Z
Q_m	0.71	-0.35	-0.36
Q_x	-0.14	0.68	-0.54
Z	0.82	0.02	-0.84

Table 3. ELASTICITIES OF OUTPUT SUPPLY AND DEMAND FOR INTERMEDIATE INPUTS WITH RESPECT TO CAPITAL

	Evaluated at Mean Values	Evaluated at 1976 Values	Evaluated at 1988 Values
Q_N	0.06	0.11	0.09
Q_M	-1.29	-1.40	-1.00
Q_x	-0.14	-0.35	-0.10
Z	-2.69	-3.00	-1.83

III. The Static Losses

The static losses of a 50% tariff and 25% wage distortion are provided in Table 4. We choose these distortions in view of the suggestion by Dornbush of maintaining uniform tariffs at 50% and because estimates of Lopez and Riveros, 1990 suggest that wages were on average about 25% above the market clearing wage in Chile in 1974-89. In order to estimate those losses we numerically integrate expressions (5) and (7) with integration boundaries of $\tau=0$ and $\tau=0.5$ for the tariff (eq. 5) and $\eta=0$ and $\eta=0.25$ for the wage distortion (eq. 7). The labor demand elasticity with respect to the wage rate and to other prices is obtained from the coefficients in Table 1 using the labor market equilibrium condition $R_L(\bullet) = w$. Thus, $(\partial \ln L)/(\partial \ln w) = (w/2\alpha_{KK}) \cdot (K/L)^2$ while the other labor demand elasticities are estimated using a similar procedure. We note that in the numerical integration of (5) and (7) we allow for the labor demand and other elasticities to change as w, p_1, p_3, and K/L change. In measuring the "pure" effect of the tariff (i.e., assuming no wage distortions) we assume that $[(\partial \ln L)/(\partial \ln \tau)] = 0$ in expression (5). Similarly, to calculate the pure effect of a wage distortion we assume $\tau=0$ in expression (7). To calculate the combined effect of the distortions we use (5) and (7) without imposing any restrictions.

The removal of the tariff would cause a once-and-for-all increase in GDP at world prices of the order of 2.1% if there are no wage distortions. Similarly, the tariff distortion at 0% wage distortion

reduces social income by 2.3%. The combined effect of the tariff and wage distortion amounts to 5.5% of GDP which is greater than the sum of the effects of each distortion separately. What happens is that the two distortions reinforce each other. The negative effect of the tariff on social income becomes larger in the presence of the wage distortion and vice versa. If there are wage distortions, the tariff increase will not only cause a price efficiency loss but also a fall in employment due to the fact that the tariff protect essentially capital intensive activities. A tariff in this case lowers the virtual market clearing wage rate and if the wage mark-up decreases to a lesser extent than the market clearing wage, employment necessarily falls. Similarly, the employment reduction due to an increase in the wage distortion will also worsen the effect of the tariff distortion by inducing an expansion of the capital intensive activities and thus, wage distortions are more detrimental in the presence of tariffs. In any case, it is important to emphasize the quantative importance of the synergy effect between the two distortions. This effect is of the order of 1% of GDP, that is, more than 20% of the sum of the independent effects of both distortions.

Table 4. STATIC OR ONCE-AND-FOR-ALL SOCIAL LOSSES OF A 50% TARIFF AND 25% WAGE DISTORTION
(% of GDP at world prices)

Wage distortion \ Tariff rate	50%	0%
0%	2.1	0
25%	5.5	2.3

III. Measuring the Social Efficiency of Capital

In this section we report on the evaluation of the expression (8) to measure the social efficiency of capital. There are two parameters in (8) that do not follow from the estimates reported in the previous section, namely, the proportion by which the average wage is above the market clearing wage rate, η, and the elasticity of the wage mark-up with respect to the market clearing wage, $\partial \ln \mu / \partial \ln w^*$. As

indicated before we use $\eta = 0.25$ as estimated in Lopez and Riveros (1990).[15/] The average elasticity $\partial \ln \mu / \partial \ln w^*$ found by Lopez and Riveros for Chile was -0.87 indicating that any increase in the market clearing wage rate causes a smaller increase in the actual wage rate. This, in turn, implies that capital accumulation that increases w^* (i.e., that increases the marginal social product of labor) will ceteris paribus necessarily decrease unemployment.

Row 1 in Table 5 shows the private returns of capital (S_k) that would prevail if there were no labor market distortions at each tariff level. As the tariff rate decreases from 50% to 0%, the private returns of capital also decline (from 0.53 to 0.50) due to the fact that the tariff protect domestic production of intermediate goods, a highly capital intensive sector. The empirical estimates suggest that the intermediate goods effects dominate the negative effect on the private return of capital of protecting the final import substitutes which are not capital intensive activities.

The private returns of capital need to be corrected to consider the effects of tariffs. This is shown in row 2 of Table 5.[16/] This correction decreases as the tariff rate is reduced. Lowering the tariff from 50% to 0% with no wage distortions increases the social return of capital about 20% from 0.42 to 0.50 (row 3). There is an 11 percentage point gain due to the capital allocational effect of the tariff but since the private return of capital declines 3 percentage points, there is a net gain of 8 percentage points as shown in row 3.

The social return of capital shows a net increase because the term $R_{33k} = \beta_{ZZk}$ is positive and highly significant dominating the negative value of $R_{22k} = \beta_{MMk}$ (see equation 10), while the effect of the other third order terms is negligible. What happens is that in Chile capital accumulation causes a very dramatic increase in domestic production of imported intermediates and a large reduction of its imports.

15/ A 25% wage distortion would imply according to our estimated labor demand elasticity of -0.14 that such a distortion would explain about 3.5 percentage points of unemployment beyond its natural rate.

16/ Corrections in row 2 corresponds to the sum of th 2nd and 3rd right-hand terms in equation (8).

Table 5. DECOMPOSITION OF THE SOCIAL RETURNS OF CAPITAL[1]

	Tariff Rate 50%	15%	0%
1. Private returns of capital[2] without labor distortions	0.53	0.52	0.50
2. Tariff efficiency correction	-0.11	-0.07	-
3. Net social returns/ no labor distortions	0.42	0.45	0.50
4. Effect of labor distortions on private return of capital[4]	-0.051	-0.048	-0.043
5. Employment correction	0.08	0.09	0.098
6. Indirect price efficiency correction	0.02	0.01	-
7. Net social returns of capital with labor distortions	0.46	0.50	0.555

1. The social return of capital measures the proportional increase of social income due to a one percent increase in the capital stock using expression (8).

2. The private return of capital measures the proportional effect of increasing capital on total income measured at domestic prices.

3. It is assumed that $\eta = 0.25$.

This aggravates the social losses of the tariff distortion because capital accumulation leads to expand production and reduce imports of a good that the country was already producing too much and importing too little. The fact that capital accumulation causes domestic production of final importables to fall does not offset the previous effect according to the empirical results. That is, by reducing domestic production of final importables capital expansion tends to decrease the distortionary effect of the tariff but this is not sufficient to compensate for the large reduction on imports of intermediate inputs.

The existence of labor market distortions requires three more corrections in calculating the social return of capital. First, labor distortions reduce the private return of capital because they cause a fall in employment which, in turn, decreases the marginal value product of capital under the weak assumption of gross complementarity between capital and labor. This correction is shown in row 4 of Table 5 fluctuating between -0.051 when the tariff is 50% and -0.043 at a 0% tariff.

Second, capital accumulation induces greater employment thus decreasing the effect of the labor market distortion. This enhances the social value of capital because expanding capital would move the economy closer to the production possibility frontier. This correction is therefore positive as shown in row 5 of Table 5. This correction corresponds to the fourth right-hand term in equation (8). Employment increases with capital accumulation because wages increase less than the marginal product of labor.

Third, the indirect price efficiency correction (row 6) accounts for the fact that the expansion in employment associated with capital accumulation may cause changes in the output mixture that may magnify or decrease the effects of the price distortion on social income. As shown in Table 5 this effect is positive as the tariff is greater than zero. Expanding employment will reduce the size of the intermediate input sector and increase their imports, thus decreasing the effect of the tariff distortion. This effect dominates the effects on the domestic final import substitution sector.

Finally, row 7 shows the net social return of capital once all the corrections required by the simultaneous existence of tariffs and labor market distortions are considered. As can be seen in row 7 the reduction of the production subsidy or tariff from 50% to 0% in the presence of a wage distortion of 25% rises the social return of capital from 0.46 to 0.555, about 21%. The wage distortion effect at each tariff rate can be obtained by comparing rows 3 and 7. The 25% wage distortion causes, ceteris paribus, an increase of the social return of capital of about 10%. This is explained by the fact that in the presence of unemployment capital accumulation induces the economy to become closer to the production possibility frontier by reducing unemployment. This implies, therefore, that the positive effect of labor market distortions on the efficiency of investment is transient and declining with capital accumulation and eventually disappears once unemployment reaches the natural rate. This is in sharp contrast with the effect of tariff or other price distortions on investment efficiency, which are likely to remain constant and even increase as capital expansion takes place. The only limit to the worsening misallocation of resources induced by capital growth when capital intensive activities are protected is the complete specialization of the economy in the protected activities.

Turning now to the likelihood of immiserizing growth, we estimated the critical tariff level that would cause, ceteris paribus, the social return of capital to be zero with and without unemployment. In the latter case the critical tariff level is about 1.85, meaning that immiserizing growth becomes an issue at a 185% tariff rate. If there is unemployment then the critical tariff level is even higher, about 260%. Thus, although the estimated parameters suggest that the conditions for immiserizing growth of capital accumulation financed by domestic savings are feasible, the required tariff levels at which this would happen are indeed very high.

Table 6 compares the contribution of capital to growth in social income under a 50% and 0% tariff assuming no unemployment. Capital is assumed to grow alternatively at 4%, 6%, and 8% per annum. These capital growth rates roughly correspond to gross investment rates of the order of 16% to

22% of GDP, which are within the range of observed investment rates for most LDCs. The first part of Table 6 indicates the contribution of capital expansion to social income growth calculated according to Table 5, under the assumption of no unemployment beyond the natural rate. With a 50% uniform tariff the social return of capital is about 0.42 and with a 0% tariff the return would be 0.50. Therefore, with a 50% tariff for example, a 4% annual increase in capital would generate an annual increase in GDP at world prices of 1.68% as shown in the corresponding entry in Table 6.

The results in Table 6 are quite striking. The effect of eliminating the 50% tariff is to accelerate the annual growth rate by almost 20%. That is, a "moderate" tariff rate of 50% causes a dramatic waste of the capital accumulation effort which is translated into a 0.32, 0.48 and 0.64 percentage points deceleration of GDP growth for the slow, intermediate and fast capital growth scenarios, respectively.

These large negative effects of tariffs on the social efficiency of investment are rapidly translated into a sizable loss of income which largely exceeds the static losses of tariff distortions. In fact, the second part of Table 6 shows the total accumulated increases in social income due to capital growth that take piace in a period of 30 years under each of the alternative scenarios. The accumulated additions to income generated by capital expansion are between 25% and 32% higher in the nontariff scenario than in the 50% tariff scenario! Social income after 30 years is between 13.5% and 23.8% higher in the no tariff case than in the 50% tariff case. These large dynamic losses are dramatically higher than the conventional static loss which in the case of Chile in 1975 (when tariffs were about 50%) were of the order of 2.1% of GDP. As can be seen in the last part of Table 6, the losses due to investment efficiency are between 6 and 11 times larger than the conventional static losses. In fact, the investment efficiency losses would cause a GDP loss as large as the static losses in only 3 years in the high capital growth scenario.

Table 6. COMPARING THE CONTRIBUTION OF CAPITAL TO GDP GROWTH UNDER ALTERNATIVE TARIFF REGIMES AND CAPITAL GROWTH RATES
(%)

I. Annual Capital Contribution to Social Income Growth

Tariff Regime	Annual Capital Growth Rate 4%	6%	8%
(1) 50%	1.68	2.52	3.36
(2) 0%	2.0	3.00	4.0
(3) Annual Rate Differential (2) / (1)	1.19	1.19	1.19

II. Increase in Social Income in 30 Years

(4) 50%	64.8	110.9	169.5
(5) 0%	81.1	142.7	224.3
(6) Total income gap after 30 years	12.1	17.2	22.4
• Due to static efficiency losses	2.1	2.1	2.1
• Due to dynamic investment efficiency losses	10.0	15.1	20.3

IV. The Relevance of the Chilean Case for Other LDCs

Chile, as any other country, has certain peculiarities that have to be considered in judging the potential applicability of the results obtained for other countries. The extent of the price and labor market distortions in Chile throughout the period under analysis has been generally more limited than those of many other LDCs. Moreover, Chile has not used quantitative restrictions to imports or exports and the full extent of the price distortion is embodied in a uniform tariff rate that has fluctuated between 70% and 10% during the 1974-89 period. Most other LDCs rely on both quantitative restrictions (QRs) and differentiated tariffs to restrict imports. At the same time they partially compensate exports with drawbacks or other export promotion schemes.

The fact that in Chile price and wage distortions are more moderate than in other countries should not affect the applicability of the results for countries that have greater distortions. Also the existence of QRs to imports or exports in other countries should not affect the relevance of the Chilean results for these countries in view of the well known tariff equivalence of QRs.

The fact that tariffs are differentiated in most countries may, however, affect the potential applicability of the results in these countries. The large detrimental effects of tariffs on the social efficiency of capital is explained by the negative effect of capital accumulation on imports of intermediate inputs which, in turn, is due to the substitutability of capital and intermediates and particularly to the highly capital intensive nature of their production in the case of Chile. In many LDCs tariffs tend to be much lower for intermediates than for final goods. This would in principle reduce the negative impact of tariffs on capital accumulation. However, many countries subject imports of intermediates to licensing and other forms of control which in one way or the other constitute additional impediments to their imports. In any case, the existence of binding QRs on imported intermediates implies that their imports are fixed but capital accumulation still magnifies the distortion because it induces greater domestic (inefficient) production of the imported intermediates.

In contrast with most other LDCs import substitutes of final goods in Chile appear to be labor intensive rather than capital intensive, while exports are more capital intensive than import substitutes of final goods. The reason for this is that the export sectors are mostly extraction and processing of natural resources (fisheries, mining and forestry), which is where Chile's comparative advantages are most prominent. These activities, however, are not only intensive in natural resources but also are characterized by a very high capital/labor ratio. This peculiar feature of natural resource rich countries such as Chile implies that import substitution activities of final goods are not relatively capital intensive vis-à-vis the export sector. This explains why a tariff on (final) import substitutes causes the efficiency of capital to increase.

In the majority of LDCs where the import substitution of both intermediate and final goods are capital intensive and protected by high tariffs, the social efficiency of capital is likely to be even lower due to the fact that capital accumulation in this case induces an expansion of not only intermediates but also final import substitutes in detriment of the export sector. Thus, the order of magnitude of the estimates for the effects of tariffs on the social efficiency of capital in Chile are not likely to be higher than those corresponding to other developing countries. The peculiarities of the Chilean economy provide reasons to expect that the Chilean estimates are more likely to be on the low rather than on the high side of the case of most other LDCs. Finally, given that the high degree of capital intensiveness of production of intermediates tend to dominate the results and given the existence of wage distortions during the period under analysis, Chile appears to share the typical structure of distortions prevailing in other LDCs. This suggests that the results concerning static losses are also quite relevant for other countries.

V. Conclusion

After a large body of empirical evidence showed that the efficiency losses associated with even large price distortions were generally small at least using the conventional competitive equilibrium

framework, economists turned to various other areas of enquiry linking growth, income and microeconomic policies. One of these areas has been the analysis of the effect of trade and other microdistortions when imperfect competition prevails in domestic markets. A second area has been the relationships between the trade regime and total factor productivity. A few recent cross-country studies have considered the effects of trade openness on the level of investment.[17/] In general, these new brand of studies for LDCs has provided mixed evidence with the total factor productivity/trade policy linkages appearing quite robust while the investment level and domestic competition linkages appearing very weak.

This paper has shifted the emphasis into a new line of inquiry, namely the measurement of the social income losses induced by the reduction of the investment efficiency caused by trade distortions. The empirical findings suggest a strong negative effect of trade distortions on the social efficiency of investment. Even what is considered a moderate (uniform) tariff at 50% could cause a reduction in the efficiency of investments of up to 23% compared with a 0% tariff scenario. The social income losses over time caused by the reduced investment efficiency are considerable. Countries that have a moderate investment ratios of the order of 20% of GDP can experience social income losses in excess of 18% in 30 years if tariffs are about 50%. Only after a few years of capital accumulation these dynamic losses become substantially larger than the conventional static losses of tariff distortions. In contrast with the static losses, the reduction of investment efficiency has cumulative effects through time which after just a few years can be several times larger than the estimated static losses.

The existence of labor market distortions causing unemployment may increase the social value of capital. This is due to the fact that capital accumulation allows the economy to become closer to the production possibility frontier by increasing employment. Since this occurs mostly because capital accumulation decreases the size of the effective wage distortion, the increased social efficiency of capital

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17/ Lopez (1990) is one of the few cross-country studies that analyzes the role of trade policies on capital accumulation.

is essentially a temporary phenomenon. This is in clear contrast with the losses of investment efficiency due to trade distortions which are essentially permanent due to the fact that the size of the trade distortion does not disappear with capital accumulation.

This study confirms previous findings regarding the relatively modest efficiency losses caused by the independent effects of specific distortions. However, we have found a considerable synergy effect when trade and wage distortions coexist which lead to larger efficiency losses. Still in the case of Chile the continued effect of these distortions is substantially below the effect of investment efficiency losses. For other LDCs characterized by a much larger number of distortions this synergy effect is likely to be even more important.

Finally, although the empirical results attain only one country, the qualitative pattern of static and investment efficiency losses is likely to be valid for most LDCs. The key issue is the combination of price distortions favoring capital intensive activity with wage distortions that cause unemployment and underemployment. As shown by Krueger (1976) and Bhagwati (1976) in their large multicountry study this pattern of distortion is indeed quite pervasive among LDCs. This paper has provided a systematic framework for the evaluation of the static and investment efficiency losses associated with interaction of two or more distortions.

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